DOCUMENT-IDENTIFIER: US 6171303 B1
TITLE: Methods and apparatus for myocardial revascularization

Brief Summary Text (26):
In some preferred embodiments of the present invention, the catheter includes a lumen for vacuum suction, which is coupled to a vacuum pump or other suitable suction device, as is known in the art, at the proximal end of the catheter. The suction lumen has an outlet at the distal end of the catheter, which is preferably immediately adjacent to the waveguide. After the distal end is properly positioned in contact with the heart tissue at a point into which a hole is to be drilled, the pump or suction device is activated. A partial vacuum is thus created at the distal outlet of the lumen, which holds the distal end in place while the laser is fired.

Brief Summary Text (53):
Preferably, the probe has a longitudinal lumen, which communicates with an orifice in a vicinity of the distal end of the probe. Preferably, the lumen is coupled proximally to a suction device, so as to create a partial vacuum at the orifice. In one preferred embodiment of the invention a surgical cutting instrument is passed through the lumen to the distal end of the probe.

Brief Summary Text (106):
Preferably, the method includes exerting suction through a lumen in the probe so as to anchor the probe to the tissue in a desired position.

Detailed Description Text (25):
Catheter 74 preferably also includes a lumen 78, preferably serving as a suction channel, which terminates in an orifice 80 at or near distal end 34. Lumen 78 is coupled to a suitable pump or other suction device, as is known in the art, in console 28. Lumen 78 may also be used for other purposes, such as for flushing or irrigating the distal end of waveguide 24 and/or heart tissue adjacent thereto and/or for passing a miniature surgical device (shown below in FIG. 4C) through to orifice 80.

Detailed Description Text (27):
FIG. 4B is a schematic, sectional illustration showing a detail of heart 50, in which catheter 74 drills an oblique TMR channel 88, in accordance with a preferred embodiment of the present invention. In this embodiment, catheter 74 is inserted through incisions in the chest wall and in the pericardium of the subject, as is known in the art, preferably minimally-invasive incisions 1-2 cm wide, and is brought into engagement with epicardium 82. A portion of catheter 74 adjacent to and including distal end 34 is placed tangentially along the surface of the epicardium at a desired position. Preferably, lumen 78 is suctioned so as to create a partial vacuum at orifice 80, thereby anchoring distal end 34 in position. Alternatively, a surgical device may be passed through lumen 78 (as shown in FIG. 4C, for example) and used to anchor catheter 74 mechanically by grasping epicardium 82, instead of using suction for this purpose. Laser source 30 is activated, so that channel 88 is drilled through myocardium 66 and endocardium 56 into ventricle 54, in the desired position and at the predetermined angle.

Detailed Description Text (30):

Whether catheter 74 operates from inside or outside of heart 50, it will be appreciated that the tangential placement of catheter 74, particularly when used in conjunction with suction through orifice 80, ensures that the catheter will remain stable while channels 68 or 88 are drilled. On account of this tangential positioning, the channels are formed at the desired angle, as determined by optical deflection element 76.

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☐ 1. Document ID: US 6231518 B1

L6: Entry 1 of 24 File: USPT May 15, 2001

DOCUMENT-IDENTIFIER: US 6231518 B1
TITLE: Intrapericardial electrophysiological procedures

Brief Summary Text (8):
U.S. Pat. No. 4,991,578 also discloses apparatuses and methods for accessing the pericardial space for placement of defibrillation electrodes. One apparatus disclosed uses suction to "pull" the pericardium against a perforating needle housed in an outer catheter, thus impaling the pericardium on the needle. Another apparatus disclosed includes a catheter through which suction is applied to draw the pericardium into the lumen of the catheter. Once drawn in, a wire suture is applied to stabilize the pericardium to the catheter, a piercing needle inserted through the pericardium, and a guidewire passed through the needle into the pericardial space. This patent also discloses accessing the pericardium from the outside (i.e., through the parietal pericardial layer) with a needle after separating the outer layer from the epicardial layer by distending the pericardial space with a fluid passed into the space through a perforation made through the atrial wall.

Brief Summary Text (14):
Preferred pericardial access devices according to the invention use suction or mechanical grasping during access of the pericardium. The preferred devices provide for separating the parietal pericardium from the epicardial surface of the heart to reduce the chance of trauma to the heart wall during access of the pericardial space. Once the pericardial space is accessed, a material transport tube can be placed into the pericardial space for administering or removing materials from the pericardial space.

Detailed Description Text (6):
A. Suction Devices

Detailed Description Text (7):
One pericardial access device for performing an outside-in approach to the pericardial space is the PerDUCER.RTM.. This device is presently in clinical trials and will be available from Comedicus Incorporated, 3839 Central Avenue N.E., Columbia Heights, Minn. 55431, the assignee of the present invention. The PerDUCER.RTM. uses suction to lift a portion of the pericardium away from the heart to provide a suitable location for penetration of the pericardium with low risk of injury to the epicardial surface of the heart. The portion of pericardium lifted away from the heart can be referred to as a "bleb." Once formed, the bleb can be punctured by a piercing instrument, such as a hollow needle, that travels into the bleb in a direction tangential to the epicardial surface of the heart.

Detailed Description Text (8):
Co-pending U.S. patent applications Ser. Nos. 08/933,858 and 08/934,045, now U.S. Pat. No. 5,972,013, disclose new and advantageous devices for outside-in access to the pericardial space through penetration of a suction formed bleb in a direction substantially perpendicular to the heart. U.S. Ser. No. 08/933,858 discloses a unique outer guide tube constructed with an inner "shoulder" to stabilize the bleb of pericardium during penetration of the pericardium. U.S. Ser. No. 08/934,045, now U.S. Pat. No. 5,972,013, discloses an outer guide tube constructed to deflect the penetrating body to enter the bleb of pericardium at a selected angle during penetration of the pericardium. The entire disclosure of both of these applications are incorporated herein by reference.

Detailed Description Text (9):
Some pericardial access devices do not use suction to lift the pericardium away from the epicardial surface of the heart. For example, co-pending application U.S. Se. No. 08/761,189, now U.S. Pat. No. 5,931,810, mechanically grasps the parietal pericardium between grasping surfaces for lifting a portion of the pericardium a sufficient distance from the epicardial surface before entering the pericardial space with a penetrating body that passes into the pericardial space between the grasping surfaces. The entire disclosure of this application is also incorporated herein by reference. An improved mechanical grasping device for pericardial access is described below.

Detailed Description Text (12):
At the proximal end 2, the pericardial access device 10 includes a handle arrangement 20 for manipulation and operation of the device. In the illustrated embodiment, the handle arrangement 20 includes a vacuum inlet 21, operating sleeve 22 and a guidewire port 23. The vacuum inlet 21 includes a vacuum channel 24 that is in fluid communication with lumen 4 of the elongate tubular body 3. The proximal end of the vacuum inlet 21 includes a connector 21 a such as a Luer fitting or threads, for connecting the vacuum source (not shown) to the device 10. The device 10 also includes a sealing mechanism 25 such as a gasket 26 at a point proximal to the vacuum inlet channel 24 which, when a vacuum is applied to the lumen 4, permits axial movement of penetrating body 5 without loss of suction to the lumen 4.

Detailed Description Text (15):
At the distal end 1, the distal opening 7 of pericardial access device 10 can be a depression 40 into the side wall 8 that is in fluid communication with penetrating body lumen 9. A hemicircular depression 41 is illustrated. When a vacuum is applied to lumen 4 of elongate tubular body 3, a bleb of pericardium forms within depression 40 that can be pierced by the piercing distal end 6 of penetrating body 5. It will be appreciated that the sidewall 8 of elongate tubular body 3 has a flattened surface 42 at the location of depression 40. The flattened surface 42 provides rotational stability of device 10 during use of the device. In the illustrated embodiment, the relative relationship of the flattened surface 42 and the vacuum inlet 21 permit the operator to verify the rotational orientation of the tip within the patient based on the orientation of the vacuum inlet 21 outside the patient. In a preferred embodiment, the side wall 8 includes a clear view tube 45 at the distal end 1 which is configured and arranged with the flattened surface 42 and depression 40.

Detailed Description Text (17):
Referring to FIGS. 5a and 5b , the piercing distal end 6 of penetrating body 5 includes a beveled edge 50 and a distal opening 51 of lumen 9 (see FIG. 3) that passes through beveled edge 50. When pin 28 is oriented at the distal end of track 29, as illustrated, beveled edge 50 is oriented up. That is, the beveled edge 50 is rotated away from the surface of the heart 61. Application of suction (arrows A) through lumen 4 lifts a portion of pericardium 60 away from the heart 61 to form a "bleb" 62 in depression 40.

Detailed Description Text (24):
In addition to cardiac applications disclosed herein, the foregoing access device can also be used for other medical applications. For example, an access device having a suction port in the side wall of the outer tubular body can also be advantageously used to perform procedures within the lumen of a tubular anatomical structure or access structures deep to the surface lining of the tubular anatomical structure when passed into the lumen of the structure. Such tubular anatomical structures include, for example, nasal passages, trachea, bronchi, esophagus, intestine, colon, rectum, ureter, urethra, vagina, uterus, blood vessels, etc. According to this aspect of the invention, for some applications, it may be advantageous for a portion of the outer tubular body and penetrating body to be flexible for selectively conforming the distal end of the device to follow the contours of the tubular organ into which the device is passed. Flexibility of the device can also reduce the chance of trauma to a tubular organ in some circumstances. Flexible materials suitable for the outer tubular body or piercing body include, for example, superelastic metals, plastics, thermoplastic elastomers (TPE), etc.

Detailed Description Text (26):
During use of the biopsy instrument 700, the pericardial access device 10 is positioned at the surface of the heart as previously described and suction applied to lift a bleb of tissue into depression 40. With the bleb secure in depression 40, the biopsy instrument 700 is advanced distally into the pericardium and rotated (arrow C) via handle arrangement 20 (see eg., FIG. 1) to excise the tissue being biopsied. The excised tissue 710 will be trapped between the scoop 703 and the wall of depression 40 as illustrated in the top view of FIG. 25 looking through clear view tube 45 at the distal end 1 of device 10. The biopsy instrument 700 is then retracted distally into lumen 8 and the pericardial access device 10 removed. The excised tissue sample 710 can then be collected for analysis.

Detailed Description Text (28):
In contrast to the pericardial access device described above, the device of U.S. Ser. No. 08/761,189, now U.S. Pat. No. 5,931,810, does not use suction to lift the pericardium away from the heart. Rather, the device lifts the pericardium away from the surface of the heart by mechanically grasping the parietal pericardium and subsequent proximal movement of the device by the operator. Similar to suction devices, a mechanical grasping device can also be used in non-cardiac procedures. Such grasping devices can further include flexible components to conform to the contours of the structure in which the device is used.

CLAIMS:

4. The method according to claim 1 wherein the step of lifting includes lifting the portion of pericardium away from the heart with suction.

5. The method according to claim 4 wherein the step of lifting the portion of pericardium away from the patient's heart is performed with a device comprising:

an outer tubular body having:

(i) a distal end; and

(ii) a lumen surrounded by a sidewall through which an applied vacuum can pass; and

a penetrating body axially mobile within the outer tubular body and having

a piercing tip suitable for penetrating the portion of pericardium.

15. The method according to claim 9 wherein the portion of pericardium is lifted

away from the heart with suction.

16. The method according to claim 15 wherein the portion of pericardium lifted away from the heart is performed with a device comprising:

(a) an outer body having:

i. a distal end; and

ii. a lumen surrounded by a sidewall through which an applied vacuum can pass; and

(b) a penetrating body axially mobile within the outer tubular body and having a piercing tip suitable for penetrating the portion of pericardium.



☐ 2. Document ID: US 6190381 B1

L6: Entry 2 of 24 File: USPT Feb 20, 2001

DOCUMENT-IDENTIFIER: US 6190381 B1
TITLE: Methods for tissue resection, ablation and aspiration

Brief Summary Text (7):
Conventional electrosurgical cutting or resecting devices also tend to leave the operating field cluttered with tissue fragments that have been removed or resected from the target tissue. These tissue fragments make visualization of the surgical site extremely difficult. Removing these tissue fragments can also be problematic. Similar to synovial tissue, it is difficult to maintain contact with tissue fragments long enough to ablate the tissue fragments in situ with conventional devices. To solve this problem, the surgical site is periodically or continuously aspirated during the procedure. However, the tissue fragments often clog the aspiration lumen of the suction instrument, forcing the surgeon to remove the instrument to clear the aspiration lumen or to introduce another suction instrument, which increases the length and complexity of the procedure.

Brief Summary Text (11):
The aspiration electrode(s) are usually located near or at the distal opening of the aspiration lumen so that tissue can be partially ablated before it becomes clogged in the aspiration lumen. In some embodiments, the aspiration electrodes(s) are adjacent to the distal opening, or they may extend across the distal opening of the lumen. The latter configuration has the advantage of ensuring that the tissue passing through the aspiration lumen will contact the aspiration electrode(s). In other embodiments, the aspiration electrode(s) may be positioned within the aspiration lumen just proximal of the distal opening. The aspiration electrode(s) may comprise a loop, a coiled structure, a hook, or any other geometry suitable for ablating the aspirated tissue. In an exemplary embodiment, the electrosurgical probe comprises a pair of loop electrodes disposed across the distal end of the suction lumen.

Brief Summary Text (12):
The electrosurgical probe will preferably also include one or more ablation electrode(s) for removing or ablating tissue at the target site. Typically, the

ablation electrode(s) are different from the aspiration electrode(s), although the same electrodes may serve both functions. In an exemplary embodiment, the probe includes a plurality of electrically isolated electrode terminals surrounding the distal opening of the aspiration lumen. High frequency voltage is applied between the electrode terminals and a return electrode to ablate tissue at the target site. During the procedure, fluid and/or non-ablated tissue fragments are aspirated from the target site to improve visualization. Preferably, one or more of the electrode terminals are loop electrodes that extend across the distal opening of the suction lumen to ablate, or at least reduce the volume of, the tissue fragments, thereby inhibiting clogging of the lumen. The aspiration or loop electrodes may be energized with the active electrode terminal(s), or they may be isolated from the electrode terminal(s) so that the surgeon may select which electrodes are activated during the procedure.

Brief Summary Text (19):
In yet another aspect of the invention, a method comprises positioning one or more active electrode(s) at the target site within a patient's body and applying a suction force to a tissue structure to draw the tissue structure to the active electrode(s). High frequency voltage is then applied between the active electrode (s) and one or more return electrode(s) to ablate the tissue structure. Typically, the tissue structure comprises a flexible or elastic connective tissue, such as synovial tissue. This type of tissue is typically difficult to remove with conventional mechanical and electrosurgery techniques because the tissue moves away from the instrument. The present invention, by contrast, draws the elastic tissue towards the active electrodes, and then ablates this tissue with the mechanisms described above

Detailed Description Text (16):
In another aspect of the invention, a loop electrode is employed to resect, shape or otherwise remove tissue fragments from the treatment site, and one or more electrode terminals are employed to ablate (i.e., break down the tissue by processes including molecular dissociation or disintegration) the non-ablated tissue fragments in situ. Once a tissue fragment is cut, partially ablated or resected by the loop electrode, one or more electrode terminals will be brought into close proximity to these fragments (either by moving the probe into position, or by drawing the fragments to the electrode terminals with a suction lumen). Voltage is applied between the electrode terminals and the return electrode to volumetrically remove the fragments through molecular dissociation, as described above. The loop electrode and the electrode terminals are preferably electrically isolated such that, for example, current can be limited (passively or actively) or completely interrupted to the loop electrode as the surgeon employs the electrode terminals to ablate tissue fragments (and vice versa).

Detailed Description Text (24):
In some procedures, it may also be necessary to retrieve or aspirate the electrically conductive fluid after it has been directed to the target site. For example, in procedures in the nose, mouth or throat, it may be desirable to aspirate the fluid so that it does not flow down the patient's throat. In addition, it may be desirable to aspirate small pieces of tissue that are not completely disintegrated by the high frequency energy, or other fluids at the target site, such as blood, mucus, the gaseous products of ablation, etc. Accordingly, the system of the present invention will usually include a suction lumen in the probe, or on another instrument, for aspirating fluids from the target site.

Detailed Description Text (25):
In some embodiments, the probe will include one or more aspiration electrode(s) coupled to the distal end of the suction lumen for ablating, or at least reducing the volume of, non-ablated tissue fragments that are aspirated into the lumen. The aspiration electrode(s) function mainly to inhibit clogging of the lumen that may otherwise occur as larger tissue fragments are drawn therein. The aspiration

electrode(s) may be different from the ablation electrode terminal(s), or the same electrode(s) may serve both functions. In some embodiments, the probe will be designed to use suction force to draw loose tissue, such as synovial tissue to the aspiration or ablation electrode(s) on the probe, which are then energized to ablate the loose tissue.

Detailed Description Text (45):
Loop electrode 103 usually extends further away from the support member than the electrode terminals 104 to facilitate resection and ablation of tissue. As discussed below, loop electrode 103 is especially configured for resecting fragments or pieces of tissue, while the electrode terminals ablate or cause molecular dissociation or disintegration of the removed pieces from the fluid environment. In the presently preferred embodiment, the probe will include 3 to 7 electrode terminals positioned on either side of the loop electrode. The probe may further include a suction lumen (not shown) for drawing the pieces of tissue toward the electrode terminals after they have been removed from the target site by the loop electrode 103.

Detailed Description Text (55):
Referring now to FIG. 7, an exemplary electrosurgical system 411 for treatment of tissue in `dry fields` will now be described in detail. Of course, system 411 may also be used in `wet field`, i.e., the target site is immersed in electrically conductive fluid. However, this system is particularly useful in `dry fields` where the fluid is preferably delivered through electrosurgical probe to the target site. As shown, electrosurgical system 411 generally comprises an electrosurgical handpiece or probe 410 connected to a power supply 428 for providing high frequency voltage to a target site and a fluid source 421 for supplying electrically conducting fluid 450 to probe 410. In addition, electrosurgical system 411 may include an endoscope (not shown) with a fiber optic head light for viewing the surgical site, particularly in sinus procedures or procedures in the ear or the back of the mouth. The endoscope may be integral with probe 410, or it may be part of a separate instrument. The system 411 may also include a vacuum source (not shown) for coupling to a suction lumen or tube 505 (see FIG. 2) in the probe 410 for aspirating the target site.

Detailed Description Text (70):
Alternatively, the probe may include a single, annular, or partially annular, electrode terminal at the perimeter of the tissue treatment surface. The central opening 609 is coupled to a suction lumen (not shown) within shaft 500 and a suction tube 611 (FIG. 8) for aspirating tissue, fluids and/or gases from the target site. In this embodiment, the electrically conductive fluid generally flows radially inward past electrode terminals 504 and then back through the opening 609. Aspirating the electrically conductive fluid during surgery allows the surgeon to see the target site, and it prevents the fluid from flowing into the patient's body, e.g., through the sinus passages, down the patient's throat or into the ear canal.

Detailed Description Text (71):
As shown, one or more of the electrode terminals 504 comprise loop electrodes 540 that extend across distal opening 609 of the suction lumen within shaft 500. In the representative embodiment, two of the electrode terminals 504 comprise loop electrodes 540 that cross over the distal opening 609. Of course, it will be recognized that a variety of different configurations are possible, such as a single loop electrode, or multiple loop electrodes having different configurations than shown. In addition, the electrodes may have shapes other than loops, such as the coiled configurations shown in FIGS. 11 and 12. Alternatively, the electrodes may be formed within suction lumen proximal to the distal opening 609, as shown in FIG. 13. The main function of loop electrodes 540 is to ablate portions of tissue that are drawn into the suction lumen to prevent clogging of the lumen.

Detailed Description Text (73):
Of course, it will be recognized that the distal tip of probe may have a variety of different configurations. For example, the probe may include a plurality of openings 609 around the outer perimeter of tissue treatment surface 612. In this embodiment, the electrode terminals 504 extend from the center of tissue treatment surface 612 radially inward from openings 609. The openings are suitably coupled to fluid tube 633 for delivering electrically conductive fluid to the target site, and a suction tube 611 for aspirating the fluid after it has completed the conductive path between the return electrode 512 and the electrode terminals 504. In this embodiment, the ablation electrode terminals 504 are close enough to openings 609 to ablate most of the large tissue fragments that are drawn into these openings.

Detailed Description Text (77):
During the process, the gases will be aspirated through opening 609 and suction tube 611 to a vacuum source. In addition, excess electrically conductive fluid, and other fluids (e.g., blood) will be aspirated from the target site to facilitate the surgeon's view. Applicant has also found that tissue fragments are also aspirated through opening 609 into suction lumen and tube 611 during the procedure. These tissue fragments are ablated or dissociated with loop electrodes 540 with a similar mechanism described above. Namely, as electrically conductive fluid and tissue fragments are aspirated into loop electrodes 540, these electrodes are activated so that high frequency voltage is applied to loop electrodes 540 and return electrode 512 (of course, the probe may include a different, separate return electrode for this purpose). The voltage is sufficient to vaporize the fluid, and create a plasma layer between loop electrodes 540 and the tissue fragments so that portions of the tissue fragments are ablated or removed. This reduces the volume of the tissue fragments as they pass through suction lumen to minimize clogging of the lumen.

Detailed Description Text (78):
In addition, the present invention is particularly useful for removing elastic tissue, such as the synovial tissue found in joints. In arthroscopic procedures, this elastic synovial tissue tends to move away from instruments within the conductive fluid, making it difficult for conventional instruments to remove this tissue. With the present invention, the probe is moved adjacent the target synovial tissue, and the vacuum source is activated to draw the synovial tissue towards the distal end of the probe. The aspiration and/or active electrode terminals are then energized to ablate this tissue. This allows the surgeon to quickly and precisely ablate elastic tissue with minimal thermal damage to the treatment site.

Detailed Description Text (80):
Referring now to FIGS. 11 and 12, alternative embodiments for aspiration electrodes will now be described. As shown in FIG. 11, the aspiration electrodes may comprise a pair of coiled electrodes 550 that extend across distal opening 609 of the suction lumen. The larger surface area of the coiled electrodes 550 usually increases the effectiveness of the electrodes 550 on tissue fragments passing through opening 609. In FIG. 12, the aspiration electrode comprises a single coiled electrode 552 passing across the distal opening 609 of suction lumen. This single electrode 552 may be sufficient to inhibit clogging of the suction lumen. Alternatively, the aspiration electrodes may be positioned within the suction lumen proximal to the distal opening 609. Preferably, these electrodes are close to opening 609 so that tissue does not clog the opening 609 before it reaches electrodes 554. In this embodiment, a separate return electrode 556 may be provided within the suction lumen to confine the electric currents therein.

Detailed Description Text (88):
During the process, the gases 714 will be aspirated through opening 609 and suction tube 611 to a vacuum source. In addition, excess electrically conductive fluid, and other fluids (e.g., blood) will be aspirated from the target site 700 to facilitate the surgeon's view. During ablation of the tissue, the residual heat generated by the current flux lines (typically less than 150.degree. C.), will usually be

sufficient to coagulate any severed blood vessels at the site. If not, the surgeon may switch the power supply 428 into the coagulation mode by lowering the voltage to a level below the threshold for fluid vaporization, as discussed above. This simultaneous hemostasis results in less bleeding and facilitates the surgeon's ability to perform the procedure. Once the blockage has been removed, aeration and drainage are reestablished to allow the sinuses to heal and return to their normal function.



☐ 3. Document ID: US 6190353 B1

L6: Entry 3 of 24 File: USPT Feb 20, 2001

DOCUMENT-IDENTIFIER: US 6190353 B1
TITLE: Methods and apparatus for bypassing arterial obstructions and/or performing other transvascular procedures

Brief Summary Text (31):
Further in accordance with the invention, there is provided a device which is insertable into a blood vessel and useable to form an extravascular passageway which extends from the blood vessel within which the catheter device is inserted to a target location. The target location may be a) another blood vessel, b) another blood containing anatomical structure (e.g., chamber of the heart), c) another location on the same blood vessel, or d) an extravascular location (e.g., organ, tumor, body cavity, etc.). The extravascular passageways formed by this catheter device may be used for performance of the revascularization and/or medical procedure methods of the present invention, as summarized hereabove. This passageway-forming catheter device may comprise an elongate, flexible catheter body having a tissue penetrating element (e.g., a member, device or flow of energy) which is passable from the catheter body, to form a passageway through the wall of the blood vessel in which the catheter is positioned, and through any other tissue located between the blood vessel and the target location (e.g., other blood vessel, anatomical structure, extravascular location, or other location on the same blood vessel) to which the passageway is desired to extend. The tissue-penetrating element may comprise a suitable type of tissue-penetrating member, device or flow of energy, including but not necessarily limited to a hollow and/or solid needle, trocar-tipped needle (with or without a surrounding pliable sheath), laser beam, laser-emitting member, electrocautery probe, hot-tipped probe, rotating tissue penetrating apparatus, or ultrasonic ablation probe. Optionally, the catheter device may be equipped with suction lumen, inflatable balloon(s) or other structural attributes or apparatus useable to facilitate or assist the passage of the tissue-penetrating element (e.g., member, apparatus, flow of energy) from the blood vessel to the selected target location. Also, optionally, the tissue-penetrating element of the catheter device may incorporate a guide wire lumen or other means for passing a guide wire through the extravascular passageway formed by the tissue-penetrating element.

Detailed Description Text (121):
FIG. 7k shows yet another alternative embodiment of a tissue-penetrating element 102k usable in the passageway-forming catheters 100 of the present invention. The tissue-penetrating element 102k shown in FIG. 7k comprises an elongate hollow needle having a lumen 316 extending longitudinally therethrough and having a sharpened distal tip. A vacuum source (e.g., suction) 344 is attached to the proximal end of the lumen 316 of the tissue penetrating element 102k so as to draw

or pull tissue into the lumen 316 as the distal end of the tissue-penetrating element is being advanced through the wall of the blood vessel BV or other tissue through which the extravascular passageway 10 of the present invention is to be formed. An optional sealing cuff 317, which may comprise an inflatable annular balloon mounted about the exterior of the tissue-penetrating element 102k a spaced distance from the sharpened distal tip thereof, may be positioned in abutment with the wall of the blood vessel BV so as to form a seal which will prevent the suction applied to the lumen 316 from the leaking outwardly or aspirating blood from the lumen of the blood vessel BV. In this manner, the optional sealing cuff 317 may facilitate drawing or aspiration of the tissue of the blood vessel wall BV or other extravascular tissue into the distal end of the lumen 316 as the tissue-penetrating element 102k is advanced through the tissue of the blood vessel wall or other extravascular tissue.

Detailed Description Text (122):
Yet another embodiment of a tissue-penetrating element 102l useable in the passageway-forming catheters 100 of the present invention, is shown in FIG. 71. With reference to FIG. 71, there is provided a tissue-penetrating element 102l formed by the combination of a standard tissue-penetrating element 102 such as a solid or hollow needle having a sharpened distal tip, and a surrounding tubular sheath 346 having a resilient, pre-bent distal portion 347 and a hollow lumen 349 extending longitudinally therethrough. The sheath 346 having the tissue-penetrating element 102 mounted therewithin is advanced through the lumen 112 of the catheter 100. When the distal portion 347 of the sheath 346 is advanced out of the distal end opening 114 of the catheter 100, the pre-bent distal portion 347 of the sheath will automatically curve or bend in a lateral direction, as illustrated by the dotted lines on FIG. 71. Thereafter, the pliable or pre-bent tissue-penetrating element 102 will be advanced through the lumen 349 of the sheath 346, and through the wall of the blood vessel BV or other extravascular tissue to form the desired extravascular passageway 10 in accordance with the present invention. Optionally, a vacuum source 345 may be connected to the proximal end of the lumen 349 of the sheath 346 to draw the wall of the blood vessel BV into contact with the distal end of the distal portion 347 of the sheath 346, thereby facilitating efficient advancement and penetration of the tissue-penetrating element 102 through the blood vessel wall or other tissue.

Detailed Description Text (123):
Yet another embodiment of a tissue penetrating element 102m is shown in FIG. 7m. With reference to FIG. 7m, here is provided a catheter 100 having a side wall opening 114 formed therein and a hollow lumen 112 extending longitudinally therethrough, and terminating at side wall opening 114. A tissue-penetrating element 102, such as a sharp-tip hollow or solid needle, is advanceable through the lumen 112 of the catheter 100 and out of the side opening 114. A vacuum source 350 (e.g., suction) is attached to the proximal end of the lumen 112 and suction is applied, to draw the wall of the blood vessel BV downwardly and into contact with the side aperture 114, as shown in FIG. 7m. Such suction-induced contact of the wall of the blood vessel BV with the side aperture 114 facilitates efficient advancement and penetration of the tissue-penetrating element 102 through the wall of the blood vessel BV, to create the desired extravascular passageway 10 in accordance with the present invention. Also, this suction attachment helps to hold the tissue which is being penetrated, in a taught state, thereby facilitating penetration of such tissue.

Detailed Description Text (126):
FIG. 8a shows a first embodiment of a passageway modifying apparatus 500a comprising an elongate tubular member having an annular, sharpened distal cutting tip 502 formed on the distal end thereof, and a hollow lumen 504a extending longitudinally therethrough. This embodiment of the passageway modifying apparatus 500a may be advanced over a guide wire GW which has been passed through the initial passageway or tract created by the tissue-penetrating element 102, such that the

annular distal cutting tip 502 will debulk or enlarge the initial tract or passageway formed by the tissue-penetrating element 102, so as to provide an extravascular passageway 10 of the desired size and configuration. It will be appreciated that, suction or vacuum may be applied to the proximal end of the lumen 504a of this embodiment of the passageway-modifying apparatus 500a to facilitate the coring of tissue by the distal cutting tip 502 such that tissue which is severed by the annular distal cutting tip 502 will be drawn in the proximal direction through the lumen 504a, and may be collected in an appropriate collection vessel for subsequent pathological examination.

Detailed Description Text (128):
FIG. 8c shows a third embodiment of a passageway modifying apparatus 500c which comprises an elongate tubular member having an annular, sharpened distal cutting tip 512 which is similar to the distal cutting tip 502 of the embodiment shown hereabove in FIG. 8a, but which is further adapted to emit energy (e.g, heat, vibration, laser light, etc.). In this embodiment of the apparatus 500c, an energy transition wire or member 514 extends through the tubular proximal portion of the apparatus 500c and is connected to the annular distal cutting tip 512 so as to transmit electrical energy, ultrasonic vibration, or any other suitable form of energy to the distal tip 512, to facilitate advancement of the distal tip 512 to the desired blood vessel wall or other extravascular tissue. The hollow lumen 504 formed through the apparatus 500c permits that apparatus 500c to be advanced over a guide wire which has been positioned within the initially formed passageway or tract created by the tissue-penetrating member. Electrical current or other energy will be passed through the energy transmitting wire or member 514 during advancement of the apparatus 500c, such that heat or other energy is emitted by the distal tip to facilitate passage and advancement of the apparatus 500c through the tissue. It will be appreciated that a vacuum source (e.g., suction) may be attached to the proximal end of the lumen 504c to further facilitate advancement of the apparatus 500c through tissue, and to draw any cored tissue through the lumen 504c such that the removed tissue may be collected in collection vessel and submitted to subsequent pathological study.



☐ 4. Document ID: US 6183469 B1

L6: Entry 4 of 24 File: USPT Feb 6, 2001

DOCUMENT-IDENTIFIER: US 6183469 B1
TITLE: Electrosurgical systems and methods for the removal of pacemaker leads

Brief Summary Text (20):
In a specific configuration, the apparatus includes a plurality of electrically isolated electrode terminals extending from the distal end of the catheter shaft. The electrode terminals are each mounted within an electrically insulating support member, and spaced peripherally around the distal opening of the catheter body. In these embodiments, the catheter may include a single, annular return electrode located proximal of the distal opening, or a plurality of electrode terminals mounted to the support members proximal of the electrode terminals. The latter embodiment has the advantage that the electric currents are confined to a distal region of the catheter body, which may facilitate advancement of the catheter through fibrous scar tissue. In this embodiment, the catheter body also includes one or more fluid delivery lumens spaced peripherally around the central lumen for delivering electrically conductive fluid to the electrode terminals. In addition,

the catheter body will preferably include one or more suction lumens spaced peripherally around the central lumen, and suitably coupled to an external suction source for aspirating fluid, tissue and/or gaseous products of ablation (e.g., non-condensible gases) from the target site.

Detailed Description Text (14):
In some procedures, it may also be necessary to retrieve or aspirate the electrically conductive fluid and/or the non-condensible gaseous products of ablation. For example, in procedures in and around the heart, or within blood vessels, it may be desirable to aspirate the fluid so that it does not flow downstream. In addition, it may be desirable to aspirate small pieces of tissue that are not completely disintegrated by the high frequency energy, or other fluids at the target site, such as blood, mucus, the gaseous products of ablation, etc. Accordingly, the system of the present invention will usually include one or more suction lumen(s) in the probe, or on another instrument, coupled to a suitable vacuum source for aspirating fluids from the target site.

Detailed Description Text (15):
As an alternative or in addition to suction, it may be desirable to contain the excess electrically conductive fluid, tissue fragments and/or gaseous products of ablation at or near the target site with a containment apparatus, such as a basket, retractable sheath or the like. This embodiment has the advantage of ensuring that the conductive fluid, tissue fragments or ablation products do not flow into the heart or lungs. In addition, it may be desirable to limit the amount of suction to limit the undesirable effect suction may have on hemostasis of severed blood vessels within heart tissue.

Detailed Description Text (36):
Catheter system 50 further includes an aspiration or vacuum system (not shown) to aspirate liquids and gases from the target. One or more internal suction lumens 130, 132 within catheter body 62 are suitably coupled to a fluid tube 97 at the proximal end of catheter 60. Fluid tube 97, in turn, includes a connector 98 for coupling to a controllable source of vacuum (not shown).

Detailed Description Text (42):
In the embodiment of FIGS. 4-7, the catheter includes a single, larger opening 424 in the center of tissue treatment surface 430, and a plurality of electrode terminals (e.g., about 3-30) around the perimeter of surface 430. Alternatively, the catheter 60 may include a single, annular, or partially annular, electrode terminal at the perimeter of the tissue treatment surface. The central lumen 424 (or a peripheral lumen) may be coupled to a suction lumen (not shown) within shaft 402 for aspirating tissue, fluids and/or gases from the target site. Aspirating the electrically conductive fluid during surgery allows the surgeon to see the target site, and it prevents the fluid from flowing into the patient's body, e.g., into the heart or lung.

Detailed Description Text (53):
Both embodiments (FIGS. 8A and 8B) include a pair of fluid lumens 126, 128 for delivering electrically conductive fluid, e.g., isotonic saline or argon gas, to the electrode terminals 76, and a pair of suction lumens 130, 132 for aspirating fluids and/or tissue fragments from the target site. The fluid lumens 126, 128 extend through catheter body 62 to fluid tube 103 (see FIG. 3). The electrically conductive fluid provides a current flow path between electrode terminals 76 and the return electrodes 120, 122, 124. In addition, the fluid is one of the requisites for establishing the Coblation.TM. mechanism of the present invention, as discussed above. Alternatively or additionally, the body's naturally conductive fluids (e.g., blood) may be used for these purposes depending on the location of the implanted object (e.g., a stent located within a blood vessel). The suction lumens 130, 132 also extend through catheter body 62 to a source of vacuum (not shown) for aspirating gaseous products of ablation and/or tissue fragments from the

target site. In addition, the suction lumens 130, 132 may be used to aspirate excess electrically conductive fluid from the target site, if, for example, a high flow rate of this fluid is necessary for the procedure.

Detailed Description Text (69):
During the process, the gases 314 may be aspirated through suction lumens 130, 132 to a vacuum source. In addition, excess electrically conductive fluid, other fluids (e.g., blood), or non-ablated tissue fragments may be aspirated from the target site to facilitate the surgeon's view and to prevent these tissue fragments or the excess fluid from flowing into the patient's heart or vasculature. During ablation of the tissue, the residual heat generated by the current flux lines (typically less than 150.degree. C.), will usually be sufficient to coagulate any severed blood vessels at the site. If not, the surgeon may switch the power supply 80 into the coagulation mode by lowering the voltage to a level below the threshold for fluid vaporization, as discussed above. This simultaneous hemostasis results in less bleeding and facilitates the surgeon's ability to perform the procedure.

CLAIMS:

11. The apparatus of claim 1 further comprising one or more suction lumens within the shaft, each having a distal opening at the distal end of the shaft, and a proximal end adapted for coupling to a vacuum source.



5. Document ID: US 6171303 B1

L6: Entry 5 of 24 File: USPT Jan 9, 2001

DOCUMENT-IDENTIFIER: US 6171303 B1
TITLE: Methods and apparatus for myocardial revascularization

Brief Summary Text (26):
In some preferred embodiments of the present invention, the catheter includes a lumen for vacuum suction, which is coupled to a vacuum pump or other suitable suction device, as is known in the art, at the proximal end of the catheter. The suction lumen has an outlet at the distal end of the catheter, which is preferably immediately adjacent to the waveguide. After the distal end is properly positioned in contact with the heart tissue at a point into which a hole is to be drilled, the pump or suction device is activated. A partial vacuum is thus created at the distal outlet of the lumen, which holds the distal end in place while the laser is fired.

Brief Summary Text (53):
Preferably, the probe has a longitudinal lumen, which communicates with an orifice in a vicinity of the distal end of the probe. Preferably, the lumen is coupled proximally to a suction device, so as to create a partial vacuum at the orifice. In one preferred embodiment of the invention a surgical cutting instrument is passed through the lumen to the distal end of the probe.

Brief Summary Text (106):
Preferably, the method includes exerting suction through a lumen in the probe so as to anchor the probe to the tissue in a desired position.

Detailed Description Text (25):
Catheter 74 preferably also includes a lumen 78, preferably serving as a suction channel, which terminates in an orifice 80 at or near distal end 34. Lumen 78 is coupled to a suitable pump or other suction device, as is known in the art, in console 28. Lumen 78 may also be used for other purposes, such as for flushing or irrigating the distal end of waveguide 24 and/or heart tissue adjacent thereto and/or for passing a miniature surgical device (shown below in FIG. 4C) through to orifice 80.

Detailed Description Text (27):
FIG. 4B is a schematic, sectional illustration showing a detail of heart 50, in which catheter 74 drills an oblique TMR channel 88, in accordance with a preferred embodiment of the present invention. In this embodiment, catheter 74 is inserted through incisions in the chest wall and in the pericardium of the subject, as is known in the art, preferably minimally-invasive incisions 1-2 cm wide, and is brought into engagement with epicardium 82. A portion of catheter 74 adjacent to and including distal end 34 is placed tangentially along the surface of the epicardium at a desired position. Preferably, lumen 78 is suctioned so as to create a partial vacuum at orifice 80, thereby anchoring distal end 34 in position. Alternatively, a surgical device may be passed through lumen 78 (as shown in FIG. 4C, for example) and used to anchor catheter 74 mechanically by grasping epicardium 82, instead of using suction for this purpose. Laser source 30 is activated, so that channel 88 is drilled through myocardium 66 and endocardium 56 into ventricle 54, in the desired position and at the predetermined angle.

Detailed Description Text (30):
Whether catheter 74 operates from inside or outside of heart 50, it will be appreciated that the tangential placement of catheter 74, particularly when used in conjunction with suction through orifice 80, ensures that the catheter will remain stable while channels 68 or 88 are drilled. On account of this tangential positioning, the channels are formed at the desired angle, as determined by optical deflection element 76.



☐ 6. Document ID: US 6162195 A

L6: Entry 6 of 24 File: USPT Dec 19, 2000

DOCUMENT-IDENTIFIER: US 6162195 A
TITLE: Method and apparatus for accessing the pericardial space

Abstract Text (1):
A pericardiocentesis apparatus and method for accessing the pericardial space. The invention consists of inserting a percutaneous tube whose tip has a hole which is positioned over and contacts the anterior pericardium. Introducing a vacuum within said tube forms a pericardial bleb within that hole. A guided needle within the tube is advanced to puncture the pericardial bleb while avoiding contact with the epicardium. A hollow filament or electrocardial lead or flexible guide wire within said needle can then be advanced into said pericardial cavity. The guide wire may be used to guide a intrapericardial catheter into the pericardial space for injection or infusion of selected therapeutic agents into the pericardial space to treat various heart and blood vessel diseases. Controlled drug release material(s) can be injected through said needle for the slow and/or sustained delivery of said therapeutic agents into said pericardial cavity.

Brief Summary Text (15):
An apparatus of the present invention for percutaneously accessing the intrapericardial space comprises an elongated outer tubular body having a closed distal end, an aperture in a sidewall adjacent the closed end, and a proximal portion for applying a vacuum thereto. An elongated inner tubular body has a distal end sealingly extending into the outer tubular body from a proximal end external to the outer tubular body, creating a first passage between the first and inner tubular bodies. A piercing body is disposed in a distal portion of the outer tubular body adjacent the aperture. The piercing body has a sharp distal end and a lumen extending through it from a proximal end of it to a sidewall opening in it adjacent such sharp distal end. The proximal end of the piercing body is connected to the distal end of the inner tubular body, thereby creating a conduit leading from outside the outer tubular body to the piercing body sidewall opening. The piercing body is longitudinally moveable in the outer tubular body to an extent permitting the distal end of the piercing body to traverse the aperture of the outer tubular body and appose the sidewall opening of the piercing body and the aperture of the outer tubular body. Means providing a passage are laterally adjacent the piercing body for permitting flow communication from the aperture of the outer tubular body to the passage between the tubular bodies, under influence of an applied vacuum, regardless of the longitudinal location of the piercing body in the distal portion of the outer tubular body.

Brief Summary Text (16):
The invention further constitutes a method for accessing a pericardial space, which comprises percutaneously inserting the distal portion of an elongated outer tubular body containing an aperture in a sidewall adjacent the distal end, locating such distal portion over the pericardium substantially parallel thereto with the aperture facing the pericardium surface, applying a vacuum to the tubular body remotely from the distal portion to draw a portion of the pericardium away from the surface of the heart into the aperture in a capture position, advancing a piercing element contained in the tubular body adjacent the aperture in a direction substantially parallel to the heart to pierce the portion of the pericardium captured in the opening, and retracting the piercing element to leave a hole in the pericardium.

Drawing Description Text (11):
FIG. 9 is a longitudinal, centerline sectional, side schematic view of the distal end of the invention illustrating capture of the pericardium with suction and formation of the pericardial bleb.

Detailed Description Text (2):
Referring to FIG. 1, an introducer apparatus 100 for percutaneously accessing the intrapericardial space and constructed in accordance with this invention, comprises a distal end portion 102 which is attached to and may be considered a distal extension of first elongate outer tubular body 104 which in turn is attached to a connector portion 106, which may be considered a proximal extension of tubular body 104. Connector portion 106 has a side branch 108 which in turn is connected to a vacuum supply 116. A second or inner elongate tubular body 112 having a distal end 111 and a proximal end 113 extends into first or outer tubular body 104 including connector portion 106 from outside outer tubular body 104, creating a passage 120 between first and inner tubular bodies 104 and 112. Passage 120 is an annulus where first and inner tubular bodies 104 and 112 are circular in cross section. At the end of connector 106 is a seal or gasket 110 which seals passage 120 inside of the tubular body 104 and connector portion 106 from ambient pressure while still permitting inner tubular body 112 to move in and out of connector portion 106. Loaded within tubular body 112 is a guide wire 114.

Detailed Description Text (3):
The distal end portion 102 is illustrated in FIG. 2 with a close-up side-view. The

bottom-view of FIG. 2 is illustrated in FIG. 3. A centerline sectional side-view of FIG. 2 is illustrated in FIG. 4. The distal end portion 102 of introducer apparatus 100 is radio-opaque, rigid, and contains an axial passage 120 which is part of a continuous passage 120 in segments 106 and 108 of outer body 104. The passage 120 in distal portion 102 terminates axially at a closure or end portion 121. A radial bore 122 in tubular body sidewall 119 adjacent closure end 121 intersects, suitably orthogonally, passage 120 and creates a cavity at 122 entered by aperture 123. Referring to FIGS. 2 and 3, a flat surface 123a surrounds aperture 123. A needle carrier block 126 is arranged and moveable longitudinally in passage 120 without occluding flow communication of fluid from aperture 123 toward branch 108 under influence of vacuum source 116. A needle 124 having an axial lumen 125 is carried in needle carrier 126 and attached to the needle carrier using a set screw 128. Needle 124 has a sharp leading or distal end 127 extending distally from carrier 126 and a trailing or proximal end 129 extending proximately from carrier 126. Needle 124 includes a sidewall lateral opening 131 adjacent sharp leading end 127 and positioned to be apposed to or alignedly juxtaposed over aperture 123 of radial bore 122 in passage 120 when needle carrier 126 is advanced in tubular body distal portion 102. At sidewall opening 131, lumen 125 accesses cavity 122 where piercing of pericardium 144 occurs. Distal end 111 of the second or inner tubular body 112 is axially connected to the trailing end 129 of needle 124, as shown in FIG. 2. This connection creates a conduit leading from externally of outer tubular body 104 through inner tubular body 112 and axial lumen 125 to needle sidewall opening 131. This enables access to the pericardial space through sidewall opening 131 after pericardium 144 is pierced. In FIGS. 1-11 this conduit is occupied by guidewire 114. The purpose of lumen 125 and the conduit leading through inner tube 112 is not to supply a vacuum to withdraw fluid. That is the purpose of passage 120, and passage 120 is much larger in cross section than lumen 125. Suitably the ratio of cross sectional areas of passage 120 to lumen 125 exceeds about 5 and may be up to about 200, more preferably from about 5 to about 100, the larger the number, the greater the vacuum force available. However, the vacuum force applied need be only sufficient to acquire and draw a bleb of pericardium into cavity 122 for piercing so that whatever is to be introduced through needle 124 can be delivered into the pericardial space so accessed.

Detailed Description Text (6):
FIG. 6 is section 6--6 of FIG. 5. As seen in FIG. 6, needle carrier 126 is relieved in an upper of its body, providing a passage 130 laterally adjacent carrier 126 permitting flow communication from aperture 123 to the portion of passage 120 proximal of carrier 126, regardless of the longitudinal location of needle carrier 126 in the distal portion of outer tubular body 102. Subambient pressure provided by vacuum source 116 results in ambient gas flow from aperture 123 of the tubular body distal portion 102, through passage 120, around needle carrier 126 at passage 130, inside the annulus portion of passage 120 to side branch 108, to the vacuum source 116. Instead of relief of the outside periphery of carrier 126, other means of passage of fluid flow past carrier 126 may be employed, including longitudinal grooves along the periphery of carrier body 126 or separate channels external to the inner periphery of tubular body 104 accessed through openings into the passage 120 located beyond the limit of travel of carrier 126.

Detailed Description Text (10):
Vacuum supply 116, connected to the branch portion 108 of outer tubular body 104, is then energized and air is evacuated from the distal portion 102 of tubular body 104 and the side opening 122 which is in contact with the pericardium 144. Once captured by suction, the pericardial sac 144 stretches to form a "bleb" 150 through aperture 123 into side opening 122 (FIG. 9).

Detailed Description Text (13):
After the hole is created in the pericardium, and with needle 124 in the fully advanced position at stop 136, the vacuum system is deactivated and a flexible guide wire 114 preloaded in needle 124 is then pushed through needle 124 into the

pericardial space 148 between the heart 146 and pericardium 144 (FIG. 11). The needle is then retracted and the apparatus 100 is percutaneously removed from the patient leaving guide wire 114 in intrapericardial space 148 as illustrated in FIG. 12. Guide wire 114 facilitates access to the interior of the pericardium.

Detailed Description Text (21):
The vacuum in tubular body 104 may also be monitored to detect a decrease in vacuum pressure marking capture of a bleb portion 150 of pericardium in aperture 123 and lateral opening 122.

CLAIMS:

5. An apparatus according to claim 1 wherein said proximal portion includes a connector mechanism for connecting a vacuum to said apparatus.

15. The pericardial access device according to claim 11 wherein said proximal portion includes a connector mechanism for connecting a vacuum to said apparatus.



☐ 7. Document ID: US 6161543 A

L6: Entry 7 of 24 File: USPT Dec 19, 2000

DOCUMENT-IDENTIFIER: US 6161543 A
TITLE: Methods of epicardial ablation for creating a lesion around the pulmonary veins

Drawing Description Text (45):
FIG. 43 shows a probe having vacuum ports for adhering the probe to the tissue to be ablated.

Detailed Description Text (132):
Referring to FIGS. 43 and 44, still another probe 318 is shown which includes suction ports 320 for ensuring intimate contact between the ablating surface 322 and the tissue. The suction ports 320 are coupled to a longitudinal channel 324 which is coupled to a vacuum source for applying suction. A cryogen delivery tube 326 delivers cryogen to boiler chamber 328 in the manner described herein.

CLAIMS:

3. The method of claim 1, wherein:

the providing step is carried out with the ablating device having at least one vacuum port coupled to a source of suction; and

the ablating step is carried out with the at least one vacuum port being adhered to a structure to stabilize the device during the ablating step.

4. The method of claim 3, wherein:

the ablating step is carried out with the at least one suction port being adhered to the surface of the patient's heart.

☐ 8. Document ID: US 6159208 A

L6: Entry 8 of 24 File: USPT Dec 12, 2000

DOCUMENT-IDENTIFIER: US 6159208 A
TITLE: System and methods for electrosurgical treatment of obstructive sleep disorders

Detailed Description Text (26):
In some procedures, it may also be necessary to retrieve or aspirate the electrically conductive fluid and/or the non-condensible gaseous products of ablation. In addition, it may be desirable to aspirate small pieces of tissue or other body structures that are not completely disintegrated by the high frequency energy, or other fluids at the target site, such as blood, mucus, the gaseous products of ablation, etc. Accordingly, the system of the present invention may include one or more suction lumen(s) in the instrument, or on another instrument, coupled to a suitable vacuum source for aspirating fluids from the target site. In addition, the invention may include one or more aspiration electrode(s) coupled to the distal end of the suction lumen for ablating, or at least reducing the volume of, non-ablated tissue fragments that are aspirated into the lumen. The aspiration electrode(s) function mainly to inhibit clogging of the lumen that may otherwise occur as larger tissue fragments are drawn therein. The aspiration electrode(s) may be different from the ablation electrode terminal(s), or the same electrode(s) may serve both functions. A more complete description of instruments incorporating aspiration electrode(s) can be found in commonly assigned, co-pending patent application entitled "Systems And Methods For Tissue Resection, Ablation And Aspiration", filed Jan. 21, 1998, the complete disclosure of which is incorporated herein by reference.

Detailed Description Text (27):
As an alternative or in addition to suction, it may be desirable to contain the excess electrically conductive fluid, tissue fragments and/or gaseous products of ablation at or near the target site with a containment apparatus, such as a basket, retractable sheath or the like. This embodiment has the advantage of ensuring that the conductive fluid, tissue fragments or ablation products do not flow through the patient's vasculature or into other portions of the body. In addition, it may be desirable to limit the amount of suction to limit the undesirable effect suction may have on hemostasis of severed blood vessels.

Detailed Description Text (43):
Referring to FIG. 1, an exemplary electrosurgical system 11 for treatment of tissue in the head and neck will now be described in detail. Electrosurgical system 11 generally comprises an electrosurgical handpiece or probe 10 connected to a power supply 28 for providing high frequency voltage to a target site and a fluid source 21 for supplying electrically conducting fluid 50 to probe 10. In addition, electrosurgical system 11 may include an endoscope (not shown) with a fiber optic head light for viewing the surgical site, particularly in sinus procedures or procedures in the ear or the back of the mouth. The endoscope may be integral with probe 10, or it may be part of a separate instrument. The system 11 may also include a vacuum source (not shown) for coupling to a suction lumen or tube 205

(see FIG. 2) in the probe 10 for aspirating the target site.

Detailed Description Text (62):
In the embodiment of FIGS. 2-4, the probe includes a single, larger opening 209 in the center of tissue treatment surface 212, and a plurality of electrode terminals (e.g., about 3-15) around the perimeter of surface 212 (see FIG. 3). Alternatively, the probe may include a single, annular, or partially annular, electrode terminal at the perimeter of the tissue treatment surface. The central opening 209 is coupled to a suction lumen (not shown) within shaft 100 and a suction tube 211 (FIG. 2) for aspirating tissue, fluids and/or gases from the target site. In this embodiment, the electrically conductive fluid generally flows radially inward past electrode terminals 104 and then back through the opening 209. Aspirating the electrically conductive fluid during surgery allows the surgeon to see the target site, and it prevents the fluid from flowing into the patient's body, e.g., through the sinus passages, down the patient's throat or into the ear canal.

Detailed Description Text (63):
Of course, it will be recognized that the distal tip of probe may have a variety of different configurations. For example, the probe may include a plurality of openings 209 around the outer perimeter of tissue treatment surface 212 (see FIG. 6). In this embodiment, the electrode terminals 104 extend from the center of tissue treatment surface 212 radially inward from openings 209. The openings are suitably coupled to fluid tube 233 for delivering electrically conductive fluid to the target site, and suction tube 211 for aspirating the fluid after it has completed the conductive path between the return electrode 112 and the electrode terminals 104.

Detailed Description Text (78):
In some embodiments, the gases 314 will be aspirated through opening 209 and suction tube 211 (see FIGS. 2 and 3) to a vacuum source. In addition, excess electrically conductive fluid, and other fluids (e.g., blood) will be aspirated from the target site 300 to facilitate the surgeon's view. During ablation of the tissue, the residual heat generated by the current flux lines (typically less than 150.degree. C.), will usually be sufficient to coagulate any severed blood vessels at the site. If not, the surgeon may switch the power supply 28 into the coagulation mode by lowering the voltage to a level below the threshold for fluid vaporization, as discussed above. This simultaneous hemostasis results in less bleeding and facilitates the surgeon's ability to perform the procedure. Once the blockage has been removed, aeration and drainage are reestablished to allow the sinuses to heal and return to their normal function.

Detailed Description Text (93):
System 400 further includes an aspiration or vacuum system (not shown) to aspirate liquids and gases from the target site. The aspiration system will usually comprise a source of vacuum coupled to fitment 614 by a aspiration connector 605.



☐ 9. Document ID: US 6159207 A

L6: Entry 9 of 24 File: USPT Dec 12, 2000

DOCUMENT-IDENTIFIER: US 6159207 A
TITLE: Protected ablation method and apparatus

Detailed Description Text (4):
As best illustrated in FIG. 2, insulating tube 36 is formed of a length of very thin tubular material and is disposed at least partly inside inner member 34 to define a lumen in which operating channels 38a-38c are formed. Also, insulating tube 36 can be made of an electrically or thermally insulating material to permit an electrical device or a thermal device such as cautery electrodes to be insulated from the rest of the instrument. Insulating tube 36 can be omitted if such insulation is not required. Of course, there can be more or less than the three operating channels 38a-38c as needed. Optical fibers 37 can be disposed in insulating tube 36 to permit light to be directed into an anatomical cavity when the distal end of protection device 30 is disposed in the cavity. A known optical coupling device can be provided to couple optical fibers 37 to a proximal end light source. Also, central lumen 39 is defined through a center of protection device 30 for passage of a known type of endoscope or other instrument, as will be described in greater detail below. Operating channels 38a-38c and central lumen 39 can be defined by thin walled tubular members or merely by void spaces defined between optical fibers 37. As shown in FIG. 1, port and valve combinations 50a-50c are provided and communicate respectively with operating channels 38a-38c through slots formed in outer member 32, inner member 34, and insulating tube 36. Port and valve combinations 50a-50c permit operating channels 38a-38c to be selectively coupled to fluid sources, vacuum sources, or other devices to permit operating channels 38a-38c to be used for irrigation, suction, dispensing medicaments, aspiration, or the like.

Detailed Description Text (5):
Surgical instrument 60 (only a proximal end of which can be seen in FIGS. 1 and 4), having any appropriate end effector such as a needle, cutting blade, cautery electrode, clip applicator or the like, can be inserted in central lumen 39 and the end effector can be advanced out of a distal end of protection device 30 when needed by compressing handle 62 which is coupled to inner member 34 and a proximal end of instrument 60. When instrument 60 is removed from central lumen 39, valve assembly 64 can be closed to seal central lumen 39 to avoid loss of fluids or pneumoperitoneum from the anatomical cavity. Lock device 63, similar to lock device 46, can be provided on handle 62 to fix instrument 60 in a desired position. Also, a channel can be defined in surgical instrument 60 and port and valve combination 68 provides access to this channel to permit an endoscope, or other viewing device, or the like to be inserted through surgical instrument 60 or to permit suction or fluid injection through instrument 60.

Detailed Description Text (14):
A second preferred embodiment of protection device 30 is illustrated in FIGS. 5 and 6. The second embodiment is similar to the first embodiment discussed above and like reference numerals are used to denote similar elements. However, in the second embodiment, protective members 52 and 54 are fan shaped with a slight inward curvature when in the open position illustrated in FIGS. 5 and 6. Flexible extending arms 56 are configured to impart the fan shape to protective members 52 and 54 when handle 44 is compressed. Operation of the second embodiment is similar to the first embodiment. However, protective members 52 and 54 may be more easily placed around irregular shaped or flat organs or other tissue. Also, in the second embodiment, instrument 60 disposed in central lumen 29 has hollow needle 61 as an end effector (which is advanced distally in FIG. 6) for piercing an organ or other tissue to permit the withdrawal of fluid, irrigation, or dispensing of medicaments such as anesthesia, through a hollow channel formed in instrument 60 and port valve combination 68. Of course, instrument 60 can have any appropriate end effector, such as a blade, a clip applicator, or a hook, or instrument 60 can be used for suction, monopolar or bipolar cauterization, or another backup procedure. Protection device 30 of the second preferred embodiment is illustrated with protective members 52 and 54 in the open position. However, protective members 52 and 54 can assume a closed position similar to the first embodiment discussed above when handle 44 is released.

Detailed Description Text (20):
A seventh preferred embodiment of the invention is illustrated in FIG. 15. Two protective members 53 formed as cupping elements are each of an extended U-shaped configuration. Slot S is defined in each protective member 53 to accommodate an organ or other tissue that is to be covered. Protective members 53 can be formed of a nonporous material to define a bladder or can be made of a porous material, such as a sponge material. Hose 69 is coupled to each protective member 53 to provide a cooling fluid, anesthesia, or medicaments to an interior of protective members 53. In the case of porous protective members 53, the fluid will pass through the outer surface of protective member 53. Of course, in such a case, the fluid must be biocompatible. Separate suction means can be provided to remove excess fluid. In the case of nonporous protective members 53, cooling is accomplished by the cooling fluid which remains inside protective member 53.

Detailed Description Text (40):
Various additional instruments can be introduced into the anatomical cavities through channels defined in the protection instrument or through separate structure sites to assist in manipulation of tissue for the protected ablation procedure or for other procedures. Such additional instruments include blunt or sharp dissecting instruments, scissors, biopsy specimen instruments, forceps, suturing instruments, suction instruments, cutting instruments, clip applicators, ring applicators, coagulating instruments, cautery instruments, sponge sticks, and the like.



10. Document ID: US 6086583 A

L6: Entry 10 of 24 File: USPT Jul 11, 2000

DOCUMENT-IDENTIFIER: US 6086583 A
TITLE: Electric cautery for endoscope

Brief Summary Text (11):
According to an aspect of the present invention, there is provided an electric cautery including a hood mounted to a distal end of an insertion part of the endoscope. At least one electrode is provided to an inner surface and/or an end surface of the hood. At least one cable extends in the channel, for supplying electricity to the electrode. The endoscope includes an elongated insertion part to be inserted into a human body cavity. The insertion part has at least one channel that opens at a distal end of the insertion part. The channel enables the suction via an opening formed on the distal end of the insertion part.

Brief Summary Text (12):
With such an arrangement, since the electrode is provided to an inner surface and/or an end surface of the hood, it is possible to cauterize a large area at a time. Further, when the suction is operated, a surface of the human body cavity is sucked in the hood. Thus, the surface of the human body cavity sufficiently contacts the electrode. This enables efficient cauterizing.

Brief Summary Text (15):
Conveniently, the hood includes a protrusion which inwardly protrudes from an inner surface of the hood. The cable and the electrode are electrically connected with each other in the protrusion. Further, the opening of the channel and the protrusion are overlapped with each other in a direction of axis of the insertion

part. Thus, the cable and the electrode can be connected in a simple manner. Furthermore, a gap is provided between the protrusion and the opening of the channel. With this, the protrusion does not interfere with the suction via the opening of the channel.

Brief Summary Text (18):
With such an arrangement, since the electrode is provided to an outer surface of the hood, it is possible to cauterize a large area at a time. Further, when the suction is operated, the human body cavity is contracted so that the surface thereof sufficiently contacts the electrode. This enables efficient cauterizing.

Brief Summary Text (24):
With such an arrangement, by urging the tip of the tube to the surface of the human body cavity, it is possible to surely cauterize a small area of the surface of the human body cavity. Further, when the suction is operated, a surface of the human body cavity is sucked in the tube so that the electrode sufficiently contacts the surface of the human body cavity. This enables efficient cauterizing.

Detailed Description Text (4):
FIG. 2 is a sectional view showing a distal end portion 11 of the insertion part 10. As shown in FIG. 2, a view window 12, a suction opening 13 and an illumination window 12a (FIG. 3) are provided at an end surface of the distal end portion 11. An object lens group 14 is provided behind the view window 12, which forms an image taken through the view window 12. Further, a CCD 15 is located at an image plane of the object lens group 14. The CCD 15 can be replaced with an image-guide fiber. The suction opening 13 leads to a suction channel 16 extending in the insertion part 10.

Detailed Description Text (6):
An electrode 52 is provided to the inner surface of the hood 51. In order to supply electricity to the electrode 52, a cable 53 is connected to the electrode 52. The cable 53 is extended through the suction channel 16 to a power source 40 (FIG. 4). The cable 53 includes a lead wire 53a and a sheath 53c formed around the lead wire 53a.

Detailed Description Text (7):
FIG. 3 is a front view of the electric cautery 50 mounted to the insertion part. The electrode 52 extends throughout the inner circumference of the hood 51. A protrusion 54 is formed on a inner surface of the hood 51. The protrusion 54 is protruded inwardly so that the protrusion 54 is overlapped with the suction opening 13. A part 52d of the electrode 52 extends to the protrusion 54. As shown in FIG. 1, one end of the cable 53 is fixed to the protrusion 54. In the protrusion 54, the lead wire 53a is connected to the part 52d of the electrode 52. Since the outer diameter of the cable 53 is smaller than the inner diameter of the suction channel 16, suction is enabled through a gap around the cable 53 in the suction channel 16. Further, a gap is provided between the protrusion 54 and the suction opening 13 so that the protrusion 54 does not prevent the suction.

Detailed Description Text (8):
FIG. 4 is a schematic view illustrating a system for operating the electric cautery 50. The proximal end of the insertion part 10 is fixed to an operation part 20. The suction channel 16 extends through the operation part 20 and leads to an opening 21 provided at a rear end of the operation part 20. The cable 53 extends to the exterior of the operation part 20 through the opening 21. The lead wire 53a of the cable 53 is connected to plus terminal of the power source 40. A contact plate 41 is attached to the surface of the human body 100 and is connected to the minus terminal of the power source 40 via a lead wire. That is, voltages of reversed polarity are applied to the electrode 52 and the contact plate 41.

Detailed Description Text (9):

A connection channel 22 is branched from the suction channel 16, which is connected to a suction apparatus (not shown) provided to the exterior of the operation part 20. Further, the operation part 20 is provided with an operation bulb 23 for controlling the suction.

Detailed Description Text (10):
The operation of the electric cautery is described. First, an operator manipulates the operation part 20 so that the hood 51 abuts the surface 101 of the human body cavity. Then, the operator turns the operation bulb 23 to start suction. With this, the surface 101 of the human body cavity is sucked in the hood 51 as shown in FIG. 5. Then, the operator presses a switch 42 of the power source 40 to apply high-frequency voltage to the electrode 52 and the contact plate 41, thereby to cauterize the surface 101 of the human body cavity.

Detailed Description Text (11):
As shown in FIG. 6, after a polyp (shown by dash-line) is removed, ends of blood lines 102 may be opened on the surface 101 of the human body cavity. However, according to the first embodiment, the surface 101 of the human body cavity is cauterized as shown by crosshatching in FIG. 7. Thus, the blood from the ends of blood lines 102 is clot. Further, the blood is partially sucked by the suction through the suction channel 16, when the inner surface 101 of the human body cavity is sucked in the hood 51.

Detailed Description Text (18):
The outer diameter of the cable 63 is smaller than the inner diameter of the suction channel 16. Further, there is a distance between the suction opening 13 and the protrusion 64 so that the protrusion 64 does not interfere with the suction. Thus, it is possible to perform suction through a suction opening 13.

Detailed Description Text (20):
First, the operator manipulates the operation part 20 so that the hood 51 abuts the surface 101 of the human body cavity. Then, the operator starts the suction so that the surface 101 of the human body cavity is sucked in the hood 61. Then, the operator presses the switch 42 of the power source 40 to apply high-frequency voltage to the electrode 62a and 62b. With such an arrangement, the surface 101 of the human body cavity can be cauterized without providing a contact plate 41 (FIG. 4) of the first embodiment.

Detailed Description Text (29):
The outer diameter of the cable 153 is smaller than the inner diameter of the suction channel 16. Further, there is a distance between the suction opening 13 and the protrusion 154 so that the protrusion 154 does not interfere with the suction. Thus, it is possible to perform suction through a suction opening 13.

Detailed Description Text (31):
FIGS. 19 and 20 are sectional views illustrating an example of operation of the electric cautery 150. In the example, ulcer 103 is formed on the inner surface of the laminal cavity 102. The electric cautery 150 (mounted to the insertion part 10) is inserted into the laminal cavity 102. In this example, the inner diameter of the laminal cavity 102 is larger than the outer diameter of the electric cautery 150 as shown in FIG. 19. In such case, when the suction is performed, the laminal cavity 102 is contracted so that the inner diameter of the laminal cavity 102 is reduced as shown in FIG. 20. Thus, the electrode 152 contacts throughout the inner surface of the laminal cavity 102, so that the electrode 152 efficiently cauterizes the ulcer 103.

Detailed Description Text (32):
As described above, according to the third embodiment, since the electrode 152 is provided to the outer surface of the hood 151, it is possible to efficiently cauterize large areas of the surface of the human body cavity. Further, since the

laminal cavity 102 is contracted by suction, the electrode 52 sufficiently contacts the surface of the cavity. This may enable efficient cauterizing.

Detailed Description Text (34):
FIGS. 22 and 23 are sectional views illustrating the example of the operation of the electric cautery 160. In this example, the electric cautery 160 is used to cut the isthmus 104 of the cavity 102. As shown in FIG. 22, the electric cautery 160 (and the insertion part 10) is moved toward the isthmus 104 in a state the electric cautery 162 is heated. With this, the electrodes 162 cut the isthmus 104 while cauterizing the cut portion of the isthmus 104 as shown in FIG. 23. Further, by operating a suction when cutting the isthmus 104, the inner surface of the isthmus 104 is moved closer to the hood 161.

Detailed Description Text (45):
FIG. 30 is a schematic view illustrating a system for operating the electric cautery 250. The proximal end of the insertion part 10 is fixed to an operation part 220. The suction channel 16 is extended through the operation part 220 and leads to an opening 221 for inserting an instrument such as a forceps, a snare, or the like. A connection tube 222 is branched from the suction channel 16 and reaches a connector 230. A connector 230 has an air/water port 231 to be connected to an air/water source and a suction port 232 to be connected to a suction apparatus. The operation part 220 has a suction bulb 223 for controlling the suction via the suction channel 16 and a air/water bulb 224 for controlling the supply of air/water.

Detailed Description Text (47):
FIGS. 31 through 34 illustrate the operation of the electric cautery 250. First, an operator inserts a high-frequency snare 18 through the suction channel 16. Then, the operator turns the suction bulb 223 to start suction (via the suction channel 16). With this, the surface of the human body cavity suffering ulcer (or cancer or the like) is sucked in the hood 251 as shown in FIG. 31. It causes a polyp 200 in the hood 251. Then, the operator cuts the polyp 200 using the high-frequency snare 18. FIG. 32 shows the surface 201 of the human body cavity, after the polyp 200 is removed. In order to cauterize the surface 201 of the human body cavity, the operator turns the suction bulb 223 to start suction again. With this, the surface 201 of the human body cavity is again sucked in the hood 251 as shown in FIG. 33. Further, the operator turns on the switch 42 to apply high-frequency voltage to the electrode 252, thereby to cauterize the surface 201 as shown by crosshatching in FIG. 34. Thus, the blood from the ends of blood lines 102 is clot.

Detailed Description Text (48):
According to the fifth embodiment, since the electrode 252 is formed on the inner surface of the hood 251, it is possible to cauterize a large area of the surface of the human body cavity. Further, since the cable 253 is located at the outer surface of the insertion part 10, the suction channel 16 can be used for inserting another instrument such as a snare, a forceps or the like. Thus, it is possible to use the electric cautery 250 and other instrument at the same time.

Detailed Description Text (55):
FIGS. 39 through 42 illustrate an example of operation of the electric cautery 270. In this example, there is a blooding portion 203 on the surface of the human body cavity as shown in FIG. 39. First, an operator inserts an injector 19 through the suction channel 16 to the blooding portion 203. The operator injects liquid (by the injector 19) under the surface of the human body cavity so that the surface is bulged as shown in FIG. 40. Then, an operator turns the suction bulb 223 (FIG. 38) to start suction from the suction channel 16. With this, the bulged surface of the human body cavity is sucked in the hood 271 as shown in FIG. 41. Then, the operator turns on the switch 42 of the power source 40 (FIG. 38) to apply voltage to the electrode 272a and 272b, so that the surface of the human body cavity is cauterized as shown by crosshatching in FIG. 42. Thus, the blood is clot.

Detailed Description Text (56):
According to the sixth embodiment, since the electrode 252 is formed on the inner surface of the hood 251, it is possible to cauterize a large area of the surface of the human body cavity. Further, since the cable 253 is located at the outer surface of the insertion part 10, the suction channel 16 can be used for inserting another instrument such as an injector, a snare, a forceps or the like. Thus, it is possible to use the electric

Detailed Description Text (60):
As shown in FIG. 43, the electric cautery 310 includes a suction tube 311. The suction tube 311 is inserted through a channel 16 of the insertion part 10 (FIG. 44). An electrode 312 is fixed to the tip of the tube 311. The suction tube 311 is made of soft and insulating synthetic resin such as fluoro ethylene, polytetra-fluoroethylene and poly-propylene. The electrode 312 is mounted to the tip of the suction tube 311 by threading (or adhering).

Detailed Description Text (61):
The outer diameter of the electrode 312 is substantially the same as the suction tube 311. A proximal end of the suction tube 311 is connected to a connector 314. The connector 314 has a terminal 315 that is to be electrically connected to a power source 340 (FIG. 44). A lead wire 313 is provided in the suction tube 311. An end of the lead wire 313 is fixed to the electrode 312, while the other end of the lead wire 313 is fixed to the terminal 315 of the connector 314.

Detailed Description Text (62):
The connector 314 has a channel 316 which is connected to the suction tube 311 and a connecting portion 317 to be connected with a suction apparatus 330. The connecting portion 317 has a tapered surface which receives a joint of the suction apparatus 330. Further, the connector 314 has a leak hole 318 connected to the channel 316. When the suction apparatus 330 is turned on, external air enters from the leak hole 318 and flows in the channel 316. When the operator shields the leak hole 18 with his finger or the like, suction is performed through the suction tube 311.

Detailed Description Text (63):
As shown in FIG. 44, the proximal end of the insertion part 10 is connected to an operation part 320. The operation part 320 includes an air/water bulb 325 and a suction bulb 326. The electric cautery 310 is inserted from an opening provided at the rear end of the operation part 320 so that the electrode 312 contacts the human body cavity 100. The terminal 315 is electrically connected to the plus terminal of the power source 40 via a lead wire 319. With this, a plus voltage is applied to the lead wire 313 (that is, to the electrode 312). A contact plate 341 is attached to the surface of the human body 100 and is connected to the minus terminal of the power source 40 via another lead wire.

Detailed Description Text (64):
The operation of the electric cautery 310 is described with reference to FIGS. 45 and 46. First, the operator urges the electrode 352 to the surface 101 of the human body cavity so that the tip of the electrode 352 surrounds an opening of a blood line 102. Then, the operator turns the suction bulb 326 (FIG. 44) to start suction by the suction tube 311. With this, the surface 101 of the human body is sucked in the electrode 312 as shown in FIG. 45. Then, the operator turns on the switch 42 of the power source 40 (FIG. 44) to apply voltage to the electrode 312, so that the surface 101 is cauterized. Ends of blood lines 102 may be opened on the surface 101 of the human body cavity. However, the surface 101 of the human body cavity is cauterized by electric cautery 310 as shown by crosshatching in. FIG. 46. Thus, the blood from the ends of blood lines 102 is clot.

Detailed Description Text (65):

According to the seventh embodiment, cauterization is performed by abutting the electrode 312 to the surface of the human body cavity and by suction. Thus, the complicated operation (like the operation of a biopsy forceps) is not necessary.

Detailed Description Text (66):
FIG. 47 is a sectional view showing the first modification of the seventh embodiment. An electrode 332 of this first modification is cylindrical-shaped and is formed on the inner surface of the tip of the suction tube 311. The tip of the electrode 352 is aligned with the tip of the suction tube 311. The cable 313 is provided in the suction tube 311 and is attached to the inner surface of the electrode 352 by means of spot welding or the like. In this modification, it is possible to intensively cauterize a small area of the human body cavity as shown in FIG. 48.

Detailed Description Text (67):
FIGS. 49 and 50 are a sectional view and a front view showing the second modification of the seventh embodiment. As shown in FIG. 49, a suction tube 351 of this second modification is so constituted that a lead wire 353 is provided in a sheath of the suction tube 351. As shown in FIG. 50, the lead wire 353 is embedded in the sheath of the suction tube 351.

Detailed Description Text (68):
As shown in FIG. 49, a proximal end of the suction tube 351 is connected to a connector 354. The connector 354 has a through hole 356 connected to the suction tube 351 and an insertion port 357 for inserting a instrument (such as a forceps, an injector, a snare or the like) into the suction tube 351. The connector 354 is connected to a connection tube 370 connected to a not-shown suction apparatus. The connector 354 is further provided with a bulb unit 360. The bulb unit 360 includes a cylinder 361 provided in a path between the through hole 356 and the connection tube 370. A spring-loaded piston 362 is slidably provided in the cylinder 361. A connection hole 364 is formed in the piston 362. When the piston 362 is pressed, the connection hole 364 is moved to a position where the connection hole 364 connects the through hole 356 and the connection tube 370. When the piston 362 is not pressed, the piston 362 is retracted (due to the force of the spring), so that the through hole 356 and the connection tube 370 are not connected. Thus, the operator can easily control the suction via the suction tube 351 with a finger.

Detailed Description Text (69):
With such an arrangement, since the cable 353 does not exist in the suction tube 351, the suction tube 351 can be used for inserting an instrument such as a forceps, an injector or the like. Thus, it is possible to use both of the instrument and the electrode 352 at the same time.

Detailed Description Text (70):
FIG. 51 is a sectional view showing the third modification of the seventh embodiment. In this modification, two electrode pins 412 are provided to the tip of a suction tube 411. The electrode pins 412 are connected to a lead wire 413 provided in the suction tube 411. In order to support the electrode pins 412, a support member 428 (made of insulation material) is provided at the distal end of the suction tube 411. The supporting member 428 is provided with a through hole 429 so that fluid can flow into the suction tube 411 therethrough.

Detailed Description Text (71):
FIG. 52 is a sectional view showing the fourth modification of the seventh embodiment. In this modification, two electrode pins 452a and 452b are provided to the tip of a suction tube 451. The electrode pins 452a and 452b are respectively connected to lead wires 453a and 453b provided through the suction tube 451. The lead wires 453a and 453b are connected to a not-shown power source. Plus voltage is applied to the electrode pin 452a and minus voltage is applied to the electrode pin 452b. In order to support the electrode pins 452a and 452b, a support member 468

(made of insulation material) is provided at the distal end of the suction tube 451. In order to separate the electrode pins 452a and 452b from each other, one electrode pin 452 is covered by an insulation cover 454. The supporting member 468 is provided with a through hole 469 so that fluid can flow into the suction tube 451 therethrough.

CLAIMS:

1. An electric cautery used with an endoscope,

said endoscope comprising an elongated insertion part to be inserted into a human body cavity, said insertion part having an image observing optical system at a distal end of said insertion part and at least one channel that opens at said distal end of said insertion part, said channel enabling suction,

said electric cautery comprising:

a hood mounted to said distal end of said insertion part;

at least one electrode provided to at least one of an inner surface and an end surface of said hood;

at least one cable which supplies electricity to said electrode, said cable extending in said channel;

said hood including a protrusion which inwardly protrudes from an inner surface of said hood, said cable and said electrode being electrically connected with each other at said protrusion.

2. An electric cautery used with an endoscope,

said endoscope comprising an elongated insertion part to be inserted into a human body cavity, said insertion part having an image observing optical system at a distal end of said insertion part and at least one channel that opens at said distal end of said insertion part, said channel enabling suction,

said electric cautery comprising:

a hood mounted to said distal end of said insertion part, said hood including a protrusion which inwardly protrudes from an inner surface of said hood;

at least one electrode provided to an outer surface of said hood;

at least one cable which supplies electricity to said electrode, said cable extending in said channel, said cable including a lead wire and a sheath covering said lead wire;

wherein said opening of said channel and said protrusion are overlapped with each other in a direction of the axis of said insertion part and said lead wire extends through said protrusion to said electrode.

3. An electric cautery used with an endoscope, said endoscope comprising an elongated insertion part to be inserted into a human body cavity, said insertion part having at least one channel,

said electric cautery comprising:

a tube inserted through said channel, said tube enabling suction;

at least one electrode provided to a tip of the tube, said electrode comprising a

plurality of pins located in a hollow portion of said tube;

at least one cable which supplies electricity to said electrode, said cable extending through said tube.

9. The electric cautery according to claim 3, further comprising a connector to which a proximal end of said tube is provided,

wherein said connector is connected to a suction apparatus.

10. The electric cautery according to claim 9, wherein said connector is provided with a control bulb that is used to control a suction through said tube.

11. The electric cautery according to claim 9, wherein a hole is formed on said connector,

a suction is enabled when an operator shields said opening of said connector.

12. An electric cautery used with an endoscope,

said endoscope comprising an elongated insertion part to be inserted into a human body cavity, said insertion part having at least one channel that opens at a distal end of said insertion part, said channel enabling suction,

said electric cautery comprising:

a hood mounted to said distal end of said insertion part;

at least one electrode provided to at least one of an inner surface and an end surface of said hood;

at least one cable which supplies electricity to said electrode, said cable extending in said channel; and

said hood including a protrusion which inwardly protrudes from an inner surface of said hood, said cable and said electrode being electrically connected with each other at said protrusion.

16. An electric cautery used with an endoscope,

said endoscope comprising an elongated insertion part to be inserted into a human body cavity, said insertion part having at least one channel that opens at a distal end of said insertion part, said channel enabling suction,

said electric cautery comprising:

a hood mounted to said distal end of said insertion part, said hood including a protrusion which inwardly protrudes from an inner surface of said hood,

wherein said opening of said channel and said protrusion are overlapped with each other in a direction of axis of said insertion part;

at least one electrode provided to an outer surface of said hood;

at least one cable which supplies electricity to said electrode, said cable extending in said channel, said cable including a lead wire and a sheath covering said lead wire, wherein said lead wire extends through said protrusion to said electrode.

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Previous Page Next Page